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# DEEP LEARNING BASED SPACE DEBRIS CAPTURE SCORING STUDY IN ON-ORBIT PROXIMITY OPERATION

## Abstract

KARI (Korea Aerospace Research Institute) has recently started research on the development of the Nano-satellite for technical verification of Rendezvous & Docking. KARDSAT (KARI Rendezvous & Docking demonstration SATellite) system consist of Chaser & Target satellite. Each satellite has a docking port and the target is equipped with the drag augmentation device for post mission disposal (PMD), the chaser is equipped with 2 vision sensors such as RGB camera and LiDAR, and fuel for docking maneuvering and re-entering the earth after the mission. Based on the technology of this project, we intend to accumulate the technology of active removal of space debris. In this presentation, the Artificial Neural Network (ANN) is applied to a vision-based tracking system with LiDAR sensor for approaching to space debris. PointNet, one of the ANN, is a classification model that utilizes point-cloud based data. It is a unified architecture that learns both global and local point features, providing a simple, efficient and effective approach for a few 3D recognition tasks. PointNet can perform three kinds of learning; 3D object classification, Part segmentation, Semantic Segmentation in Scenes. We applied algorithm for Part segmentation to solve the current problem. The uncontrollable space debris to be removed can change shape due to collision with other space objects. This cannot be predicted, and it can be inferred that the capture part of the situation will also change. We use the Part segmentation of PointNet to learn shapes after various collisions of space debris, and draw out the results of classifying what it is. The category of the classification model is scored for capture difficulty, and its category is as follows; Payload, Solar panels, Antennas, Star tracker, etc. al. The part segmentation of PointNet uses the 2 multi-layer perceptron and mixed the global feature and local point feature. It uses two kinds of features to improve accuracy. After that, score the remaining part of the space object to determine the difficulty level for the capture. Our target is the KOMPSAT series, satellites operated by KARI. The application of this technology may be part of an effort to meet the 25-year rule when its satellites are terminated in unexpected circumstances.